THE AMERICAN MINERALOGIST

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SOME ASSOCIATIONS OF ORE MINERALS*

H. E. MERWIN, *Geophysical Laboratory.*

In the formation of minerals, heat may be considered with respect to (1) the temperature gradient downward from the earth's surface, and (2) the depth which represents an environmental pressure at which the mineral-forming process is active, and (3) the gas or vapor pressure of the phase from which the mineral is depositing.

The relations of these conditions may be treated here under two cases, the first of which will be commented upon before the second is mentioned. In the first case the temperature gradient is so low that at any depth a liquid in the rock has a vapor pressure less than the environmental pressure. The latter pressure has at maximum the pressure of rock load plus the strength of the rocks to resist displacement, and at minimum, the pressure of the superincumbent liquid (+ gas) column plus the capillary or frictional resistance to movement of this column.

Water filling the pores of rocks near the surface extends downward into increasingly hotter rocks. As temperatures increase downward more rock material enters into solution with the water until, at depth, liquid and rock merge and lose their identities in a magma.

If there could be realized a continuous column of liquid grading in concentration from the surface downward to magmatic depths, the difference between the weight of the column and of a similar column of rock would be a measure of the incentive to upward movement of the liquid column. A tendency toward such movement must exist in vertical openings in rocks, but movement is scarcely realized ordinarily on account of frictional resistance, ex-

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*Presidential address presented at the eleventh annual meeting of the *Mineralogical Society of America*, in joint session with the *Geological Society of America*, Toronto, Canada, December 29, 1930.

cept in larger openings and their direct connections. With respect to suddenly opened fractures, liquid would be potentially explosive. Liquid magma bursting into such a fracture might solidify so as to preserve vesicles formed during the sudden relief of pressure. More hydrous liquids thus intruded would deposit some crystals immediately on the neighboring walls of the fracture and from them slowly build toward the middle a crystalline filling, leaving a residuum increasingly hydrous which would move upward at intervals.

One general mineral association which may be referred to the deeper environment just described[1] is the granite pegmatite. Intrusive bodies of this type have compositions and structures which have led to the conception that they have been derived from a residuum, or from successive residua, of cooling granitic magma. These residua become increasingly hydrous, and enriched in a variety of compounds which, because of high solubility in the liquid, or slight original concentration, have remained in solution until cooled by intrusion as detailed above. Reopening of the fissures after periods of cooling allows successive invasions of liquids, each in general presumably cooler than the preceding, and thus in a state of saturation ready to deposit new compounds, or to dissolve or react with and replace existing minerals. Both Schaller[2] and Hess[3] have presented much evidence for a common replacement sequence—potash, soda, lithia.

Minerals rich in the elements barium, strontium, nickel, cobalt and chromium are almost absent from acid pegmatites, but these elements are known to be present in solid solution in common rock-forming minerals. Therefore their concentration in a residual liquid would be partly prevented.

Copper, zinc and lead are not absent from pegmatites, but pegmatites are not the home of their ores. They are not definitely known as solid solution constituents of common rock-forming minerals. When we have learned, for the oxygen, sulfur and arsenic compounds of the several elements enumerated, something about the relative solubilities in dry and in highly hydrous rock liquids, then we shall be able to picture more definitely the relative importance of early and late segregation of the elements in a cooling deep-seated magma.

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[1] G. W. Morey, *Jour. Geol.*, **32**, 294, 1924, has been led by experimental work to the opinion that critical phenomena do not appear in natural liquids containing an abundance of both water and silicates.

[2] W. T. Schaller, The Genesis of Lithium Pegmatites, *Am. Jour. Sci.*, **10**, 269, 1925; Mineral Replacements in Pegmatites, *Am. Mineralogist*, **12**, 59, 1927.

[3] F. L. Hess, Natural History of Pegmatites, *Eng. Min. Jour.-Press*, **120**, 289, 1925.

Thus far our attention has been directed to the condition in which the temperature gradient downward is so low that liquid in the rocks has a vapor pressure below the environmental pressure, that is, pressure with respect to temperature is maximal. This condition is favorable for developing at depth a liquid containing abundance of both water and silicates.

Now we may consider that the temperature gradient from the surface is sufficiently steep to produce in the liquid of the rock a vapor pressure higher than the minimum environmental pressure. This is the condition required for the presence of a gas phase. If the temperature gradient is only slightly higher than in the condition previously described the gas phase will develop at intermediate depths, while if the gradient is steep[4] hot gas will fill the pores of the rocks near or at the surface.

Consider a finely brecciated vertical zone of rock of intermediate composition with pores at first filled with water. At a depth of a few thousand feet the mass has been subjected from below to a rapidly increasing temperature, so that the joint blocks are being dissolved to form a hydrous liquid highly concentrated in the constituents of the rock. The vapor pressure of the solution is decreased by concentration and increased by temperature. At some intermediate depth the vapor pressure of the solution exceeds the environmental pressure, and vesicles form in the liquid of the narrow joints. But because of the postulated rising temperature, the rock in the vicinity of the vesicles is getting hotter, therefore the vesicles become extended over a vertical range.[5] At the ends of the range, liquid, gas, and crystals exist in contact, but at intermediate levels, liquid tends to disappear and leave the rock pores filled only with gas. The tendency, however, is only partly realized, for in a mass of rock in which several crystal phases are present in irregular distribution, and in contact with films of liquid, there is a range of temperature at a given pressure at which gas and liquid phases may persist.

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[4] For some recent studies of hot springs and fumaroles see E. T. Allen and A. L. Day, Steam Wells and Other Thermal Activity at "The Geysers," California. *Carnegie Inst. Publ. No.* **378**, 1927. E. G. Zies, The Valley of Ten Thousand Smokes: I. The Fumarolic Incrustations and their Bearing on Ore Formation. *Nat. Geographic Soc., Contributed Technical Papers, Katmai Series No. 4*, **1929**.

[5] Suppose vesiculation be delayed and supersaturation exist while temperature is rising, then the conditions for vesiculation will be present at levels both above and below the original levels of vesiculation.

When vesicles first form, the liquid just above them has the same temperature and composition as that just below them, but as vesicles elongate vertically the liquid above them has both lower temperature, and lower concentration of rock constituents. As the thickness of the vesicular zone increases, the difference between the upper and the lower liquids increases. Pressure is no longer maintained at substantial equality at the top and the bottom of this gas cushion. The higher temperature at the bottom causes streaming of the gas through pores toward the top, where absorption of the gas by the upper liquid takes place.

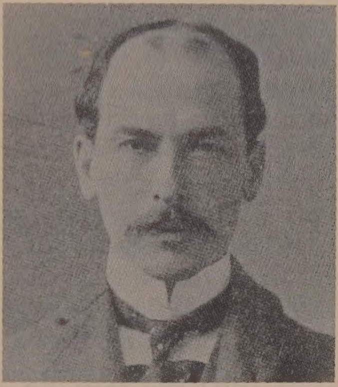
Transfer of heat by the streaming gas is much faster than through the intervening blocks of rock. The shapes and sizes of the blocks and pores will thus affect the distribution of gas and liquid in pores and crevices. The interiors of blocks will be enough cooler at first to maintain liquid films into which volatiles from the gas in the crevices will be absorbed. But such films will gradually be displaced by gas as the whole environment gets hotter, and as the volatiles of the liquid evaporate. Thus as the gas cushion grows thicker the rock into which the gas is penetrating is subject to reactions with gas and liquid, some volatiles are absorbed and held in new crystals, others already present in the rock may be given up to the liquid or gas.

Increased volume due to thickening of the gas cushion forces the upper liquid toward the surface through the more open rock crevices. The flow includes liquid which is derived from near the cushion, and which contains volatiles from the lower liquid, or released from the rocks as indicated above. Such a process of leaching, recrystallization and introduction of volatiles may well be considered in attempts to account for the loss of lime, magnesia and soda from, and the introduction of sulfur and copper into, the porphyries of the disseminated copper deposits.

MEMORIAL OF LEA McI. LUQUER

PAUL F. KERR, *Columbia University.*

In 1658 Jean L'Escuyer of Paris landed in America. He settled on Long Island, and, a few years later, married. He was a respected citizen, owned and operated a mill, and held a position as elder in the Dutch Church. His great-grandson, Abraham Luquer, was the first to adhere to the present spelling of the name in Dr. Luquer's branch of the family. Abraham Luquer owned a farm in Brooklyn, on Gowanus Bay, and there Dr. Luquer's father, Rev. Lea Luquer, was born; and lived, until his marriage, in 1860. The Reverend Lea Luquer graduated from Columbia College in 1852. He then studied law with the well-known firm of Kent and Eaton, was admitted to the bar, and practised for several years before he decided to enter the ministry. He was ordained in 1863, and took charge of the organization of the Church of the Atonement, in Brooklyn. It was in Brooklyn that Dr. Luquer was born, September 4, 1864. In 1866 the Reverend Lea Luquer's health caused him to give up his city parish and accept a call to St. Matthew's Church, Bedford, New York, in which charge he continued until his death in 1919.



Lea McIlvaine Luquer
1864–1930

Dr. Luquer received his early education from his father. In 1879 he was sent to Trinity Military Institute, at Tivoli-on-the-Hudson, where he prepared for college. He made a splendid record at the school, and when he graduated received a special prize for outstanding excellence in all of his work. In 1885 he entered the School of Mines, Columbia University, where he made an enviable record and from which he graduated in 1887, with the degree of civil engineer. In 1896 he married Anne Low Pierrepont, daughter of Henry E. Pierrepont, of Brooklyn.

His first experience in teaching was in 1887, under Professor Munroe, as an assistant in surveying, at the Summer School near Litchfield, Connecticut. This postponed his attempts to look for work, and when college opened in September he was in search of employment. He chanced to hear of a fellowship available in mineralogy, through Professor Moses, then a tutor in the department. After interviewing Professor Egleston he received the fellowship, and remained in mineralogical work throughout the remainder of his life.

Dr. Luquer was one of the early workers in optical mineralogy, in America. His thesis work at the School of Mines, from which he was granted the doctorate in 1894, was along the lines of optical mineralogy. In 1898 he published the first edition of his book *Minerals in Rock Sections*. The book has been one of the most successful in its field, being used not only in this country; but in many other parts of the English-speaking world. Dr. Luquer traveled extensively in Europe, gaining much of his experience in optical mineralogy from European study.

In addition to his book on minerals in thin sections, he published numerous technical articles on various phases of mineralogy. Not only was Dr. Luquer interested in the progress of mineralogy as a science, but he was even more devoted to his work with students. Few men have had such poise, and the ability to meet all situations, with apparent ease.

In addition to his university work Dr. Luquer was always engaged in outside activities. For many years he was active in the support of the New York Kindergarten Association. He also belonged to the City club of New York, and to the Century association.

In the field of mineralogy, aside from his professorship at Columbia, he was from 1926 until his death, research associate in the department of mineralogy of the American Museum of Natural History. He was a fellow of the New York Academy of Science, and of the Mineralogical Society of America; and a member of the American Association for the Advancement of Science.

Dr. Luquer suffered a heart attack in the spring of 1924. He was granted a year's sick leave, and retired from Columbia in 1925. He went to Europe in an attempt to regain his health. After a few years of retirement, when he had apparently regained much of his former vigor, he died suddenly January 30, 1930. Beside Mrs. Luquer he is survived by four children, Lea Shippen Luquer, Thatcher Payne Luquer, Evelyn Pierrepont Luquer, and Ellen Pierrepont Luquer, now Mrs. Thomas L. Purdy.

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MEMORIAL OF FRANK ALONZO WILDER

J. J. Runner, *State University of Iowa.*

With the passing of Frank A. Wilder of North Holston, Virginia, on March 8, 1930, the science of mineralogy has suffered a great loss. With a thorough training in pure science as a background, Dr. Wilder found his most important work in life the applying of science to industry, and his chief contributions have been in the field of economic mineralogy. Possessing rare qualities of leadership his value as an executive was paramount and yet in spite of the exacting demands of industry upon his time he never lost interest in scientific research nor failed to realize its value.

Dr. Wilder was born at Akron, Ohio, February 2, 1870. He graduated from Oberlin College in 1892. After graduation he pursued postgraduate studies at Yale, Freiberg and the University of Chicago, receiving the Ph.D. degree in geology from Chicago in 1902. He was instructor in science in the high school at Fort Dodge, Iowa, from 1894 to 1897, and in the Des Moines, Iowa, high school from 1897 to 1900. He was associate professor of geology in the University of North Dakota during the year 1902–03, and was professor of petrology, economic geology and mining in the State University of Iowa from 1904 to 1906. Dr. Wilder was assistant state geologist of Iowa during 1901 and state geologist from 1904 to 1906, when he resigned to organize and become director of the Southern Gypsum Company, with headquarters at North Holston, Virginia. He remained with this company until 1927 when it was purchased by the Beaver Products Company.

Dr. Wilder was a fellow of the Mineralogical Society of America, of the Geological Society of America, of the Society of Economic Geologists, of the American Association for the Advancement of Science, a member of the Society of Testing Materials and other learned societies.

Dr. Wilder's best known publication is his monograph entitled, "Gypsum: its Occurrence, Origin, Technology and Uses, with Special Chapters Devoted to Gypsum in Iowa," which was published in Vol. **XXVIII** of the publications of the Iowa Geological Survey in 1918. This splendid scientific and technological treatise remains to date one of the most, if not the most, complete work on the subject of gypsum ever published and is a fitting monument to the name of a thorough and enthusiastic scientist.

In the preface to his treatise on gypsum Wilder says: "This volume is the outgrowth of an interest in gypsum which has extended over twenty-five years. While the writer was teaching science in the Fort Dodge High School from 1894 to 1897 the gypsum beds furnished a most interesting field for personal study and for class excursions. Later while he was acting as assistant state geologist, the preparation of the report on Webster County was assigned to him, and opportunity was given for further study of the Fort Dodge beds. The Webster County gypsum furnished the theme for a doctor's thesis in 1902. During the past fifteen years an active interest in the industrial applications of gypsum has not lessened interest in the theoretical problems connected with this mineral, while it has led to a study of the literature dealing with its technology and chemistry."

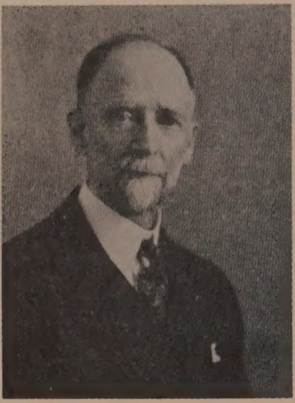
Dr. Wilder was a cultured gentleman of wide learning, high character and great usefulness whose passing will be mourned by many friends. During his short tenure at the State University of Iowa, he made an enviable reputation as teacher and scientist which still remains alive.

MEMORIAL OF ALJA ROBINSON CROOK

A. J. Walcott, *Northwestern University.*

Doctor Alja Robinson Crook was born in Circleville, Ohio, June 17, 1864. His father, Rev. Isaac Crook, was a Methodist minister.

Dr. Crook graduated from Ohio Wesleyan University in 1887. After graduation he held the position of Superintendent of Public Schools, at Mt. Carmel, Ohio, from 1887–1889. From 1889 to 1892 he spent much of his time abroad continuing his scientific preparation. He acquired this preparation by studying in a number of leading Institutions. Among these should be mentioned the British Museum in London, Jardin des Plantes in Paris, University of Zürich and the University of Munich. The degree of doctor of philosophy was conferred upon him by the University of Munich. Dr. Crook pursued his major work for the doctor's degree in the field of paleontology and presented a thesis entitled: "Ueber einige Fossile Knochenfische aus der Mittleren Kreide von Kansas." This was published in *Paleontographica*, Vol. **39**, 1892.



Alja R. Crook
1864–1930

After returning to America Dr. Crook served for one year, 1892–93, as professor of natural history at Wheaton College, Wheaton, Illinois. In 1893 he came to Northwestern University as professor of mineralogy and petrology. This title was changed to professor of mineralogy and economic geology in 1898. He was head of the department in which he held his professorship. During his first two years at Northwestern University Dr. Crook collaborated with the department of geology by teaching in this department two courses, one in paleontology and one in historical geology.

In the summer of 1906 Dr. Crook was appointed curator of the State Museum of Illinois, which was then housed in one room of the State arsenal. Under his direction the museum expanded very rapidly and it now occupies a large part of the space of the new Centennial building of the State fair grounds.

Since 1917 Dr. Crook has served as chief of the State Museum Division of the Department of Education.

Dr. Crook died at his home in Springfield, Illinois, on the afternoon of May 30, 1930. His death means a great loss to the educational interests of mineralogy. He possessed a great love for minerals and sincerely believed that a study of them was of great cultural value, and that it helped in the preparation for right living. Dr. Crook admired Werner and adopted Werner's methods in teaching mineralogy.

Dr. Crook was a great lover of the out-of-doors. It is said of him that he was an enthusiastic mountain climber. In connection with his teaching he conducted many field excursions. He attended the International Geological Congress when it met in St. Petersburg, Russia, in 1897, and brought back from his trip a large number of specimens and photographs. In the summer of 1899 he conducted a party of students to a number of well-known western localities to collect fossils.

After the World's Fair in Chicago in 1893, it was largely through his influence that a large portion of the natural history collection was obtained for the museum of Northwestern University.

Dr. Crook was the author of several publications. Among these the *Guide to Mineral Collections* is used as a text in a number of colleges and as a standard reference work in museums. During the year 1914–15 he was president of the Illinois Academy of Science. For a number of years he was instrumental in having the proceedings of the Academy properly arranged and published. He left unfinished a large chart showing the various formations of the earth's crust. For this work he had obtained samples from many parts of the world.

Dr. Crook was a fellow of the American Association for the Advancement of Science, the Geological Society of America, Mineralogical Society of America, and a member of the Deutschen Geologischen Gesellschaft, the American Association of Museums and Sigma Xi.

NOTES AND NEWS

THE OCCURRENCE OF GYPSUM CRYSTALS IN THE VIRGINIA EOCENE

BENJAMIN GILDERSLEEVE, *University of Virginia.*

During the summer of 1930 studies were made on the Eocene formations lying between the Potomac and Rappahannock rivers in the vicinity of Fredericksburg, Virginia. The most interesting problem of a mineralogical nature is the occurrence of gypsum (selenite) crystals in the Nanjemoy formation of Upper Eocene age. The earliest reference in the literature to such an occurrence in Virginia is that of Rogers in 1834, mentioned in his reprint of 1884.[1]

Later, other references to the Virginia and Maryland occurrences were made by W. B. Clark, G. B. Shattuck and B. L. Miller.[2]

In all the references little is said in regard to the mode of occurrence or physical character of the crystals. The Nanjemoy formation consists of greensands, sands and clays. As far as has been observed the gypsum crystals are restricted to the lenses of clay. Their prevailing habit of occurrence is a rosette form, resembling pyramids or spires, radiating from a common center. In other words the crystals are mostly compound, though in a number of instances single crystals have been found. In many places where fresh surfaces of the clay were exposed, these clustered crystals were found at the intersections of one or two sets of joint planes with the bedding planes. Such an occurrence suggests their form to be due to growth starting at the intersection and extending outward along these several planes as directions of easiest growth.

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[1] Rogers, W. B., *Geology of the Virginias.* D. Appleton and Co., *New York*, **1884,** pp. 7, 17, 19, 26, 50, 52, 53, 56, 58, 60, 61, 127, 129, 141, 436, 437.

[2] Clark, W. B., The Eocene Deposits of the Middle Atlantic Slope in Delaware, Maryland and Virginia. *U. S. Geol. Survey, Bull.* **141,** 1896, pp. 40, 43.

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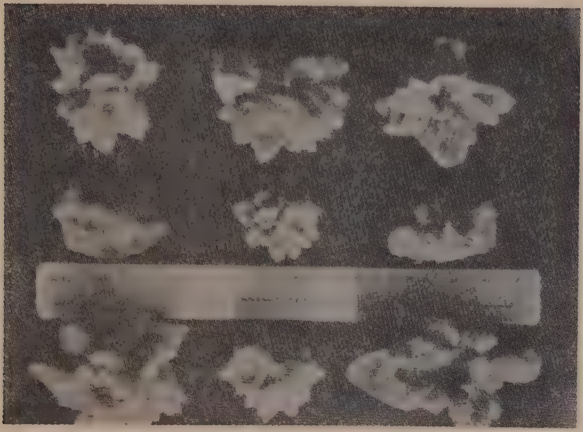

FIG. 1—Photograph showing cluster of gypsum crystals, and one single crystal to left side and middle row.

In size the clusters may vary from an inch or less, to as much as four inches in diameter. The clusters are usually about equidimensional and are made up of from five to twenty-five crystals arranged in such a way as to produce basin-like depressions with three to ten in each cluster. These depressions have been developed apparently by solution of the crystals and themselves radiate from a common center. In some cases there may be two or more prolonged growths.

The crystals vary in size from one-tenth of an inch to one inch in diameter. They are imperfectly formed with the prism and pinacoidal faces best developed. In the majority of cases they are truncated and frequently hollowed out. Small crystals often line the inner surfaces of the vug-like cavities and represent later crystallizations. The crystals are transparent to semitransparent, depending on the amount of inclusions present, and are colorless to gray.

In observing similar crystals in the Miocene, Rogers attributed their occurrence to permeating waters carrying sulphuric acid which resulted from the disintegration of sulphate of iron. This acid with the lime formed the sulphate of lime or gypsum.

The occurrence of this gypsum, as far as is known, is only of scientific interest.

ATTENTION OF MINERAL COLLECTORS

The Mineralogical Society of America is attempting to compile a list of the more important mineral collections, both public and private, in the United States and Canada, the intention being to publish this information in the form of a regional directory in the *American Mineralogist.*

While the securing of the necessary data relating to the larger public collections housed in museums and other institutions presents little difficulty, the task of collecting information upon the smaller private collections, either general or specialized, that exist on this continent is more formidable. It is believed that there probably exists, in various smaller centers and mining districts, a wealth of interesting and valuable mineralogical material, some of it possibly collected years ago and from localities no longer accessible, which is virtually unknown to the scientific world. It is of decided value and interest to the owners of such material that the existence of their collections should be recorded, both from the standpoint of the possible scientific value of the material and with a view of enabling the owners to establish contacts with mineralogists who may find themselves in their districts and desire to examine the collections.

Accordingly, the Mineralogical Society of America wishes to ask all readers of this announcement who may be mineral collectors, and who own either general or specialized collections, to kindly send their names and addresses, together with a brief note on the nature of their material, to the address given below. If the collection is specially rich in minerals of a particular mine, locality or district, this should be mentioned, as should also the inclusion of any specialized types, such as gems, meteorites, or other notable rarities.

In the case of public collections, the name of the institution together with the name and address of the custodian or director, are desired.

In addition, the Society would welcome information, with notes as above, regarding other collections known to the correspondents, and which they consider should be included in the directory.

Details relating to collections consisting wholly of the minerals and ores of an individual mine, and on permanent exhibit at the mine office, will also be welcomed from mine owners, managers, superintendents, and engineers. The names and addresses of small local dealers specializing in the minerals of particular localities will also be of interest.

Since the success of the survey being made will very largely depend upon the cooperation of those individuals in possession of this information an earnest appeal is made for as full, complete and prompt replies as possible. Address all correspondence to *Samuel G. Gordon, Philadelphia Academy of Natural Sciences, Logan Square, Philadelphia. Pennsylvania.*

PROCEEDINGS OF THE ELEVENTH ANNUAL MEETING OF THE MINERALOGICAL SOCIETY OF AMERICA AT TORONTO, CANADA

Frank R. Van Horn, *Secretary.*

The Mineralogical Society of America held its eleventh annual meeting on December 29 and 30, 1930, in conjunction with the Geological Society of America, at the University of Toronto, Toronto, Canada. On Monday, December 29, at 2:00 P.M., in Room 56, Mining Building, President H. E. Merwin called the regular annual meeting to order. On motion of the Secretary, the reading of the minutes of the last annual meeting was dispensed with, in view of the fact that they had been printed on pages 109–122 of Volume **15** (Number 3) of the *American Mineralogist*.

ELECTION OF OFFICERS AND FELLOWS FOR 1931

The Secretary announced that 177 ballots had been cast unanimously for the officers as nominated by the Council. For fellows there was a unanimous vote of 81 ballots in the affirmative. All officers and fellows were declared elected.

The officers elected for 1931 are the following:

President: Alexander H. Phillips, Princeton University, Princeton, New Jersey.

Vice-President: William F. Foshag, U. S. National Museum, Washington, D. C.

Secretary: Frank R. Van Horn, Case School of Applied Science, Cleveland, Ohio.

Treasurer: Waldemar T. Schaller, U. S. Geological Survey, Washington, D. C.

Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.

Councilor, 1931–1934: William S. Bayley, University of Illinois, Urbana, Illinois.

The fellows elected follow:

Mr. Harry Berman, assistant in the Mineralogical Museum, Harvard University, Cambridge, Massachusetts.

Dr. Paul Niggli, professor of petrography and mineralogy, Eidgenössische Technische Hochschule, Zürich, Switzerland.

Dr. Paul Ramdohr, professor of mineralogy and economic geology, Technische Hochschule, Aachen, Germany.

REPORT OF THE SECRETARY FOR 1930

To the Council, Fellows and Members of the Mineralogical Society of America: The Secretary herewith begs to report that the roll of the Society now comprises **114** fellows and 274 members in good standing, which is exactly the same number as last year. Three fellows, A. R. Crook, L. McI. Luquer, F. A. Wilder and one member, W. E. Mumford, have died during the year. In addition to the 388 fellows and members, there are 214 subscribers, a gain of 15 for the year. A total of 602 paid copies of the journal are mailed monthly, an increase of 15 over last year. Actually during the past year 3 fellows, 53 members and 26 subscribers, a total of 82, were added to the list, but deaths, resignations, with non-payment of dues and subscriptions, have reduced the mailing list by 67 names. The Secretary wishes to acknowledge the efficiency of the Treasurer, Professor A. B. Peck, and express his regret that he no longer feels able to serve in that capacity.

Respectfully submitted,
Frank R. Van Horn, *Secretary*

On motion, the report of the Secretary was accepted and ordered filed.

REPORT OF THE TREASURER FOR 1930

The Treasurer read his report, and on motion made and seconded, it was accepted and ordered filed. On motion an auditing committee composed of nonmembers of the Council was appointed by the President. This committee, consisting of L. S. Ramsdell, C. B. Slawson and N. L. Bowen, later during the meeting reported to the Society that they found the books of the Treasurer correct and that they had also inspected the securities owned by the Society. The Treasurer's report follows:

To the Council of the Mineralogical Society of America: Your Treasurer herewith submits his annual report for the year ending November 30, 1930.

Receipts

Cash on hand December 1, 1929	$1,557.04	
Dues and subscriptions	2,107.52	
Advertisements	491.32	
Sale of back numbers	325.01	
Interest on endowment	2,534.00	
Miscellaneous	4.78	
		7,019.67

Disbursements

Printing and distribution of the Journal (12 issues)	$3,591.60	
Printing of separates	147.56	
To the Editor, Secretary, and Treasurer	720.00	
Postage and stationery	199.09	
Miscellaneous	212.40	
1—$1000 Bond, Denver Gas and Electric Light Co., 5% due 1951	1,051.61	
	5,922.26	
Cash on hand November 30, 1930	1,097.41	
		7,019.67

The endowment funds of the Society as of November 30, 1930, consist of:

45 $1000 bonds of the City and County of Honolulu, Water Works, 5%	$45,000.00
4 Liberty bonds, $100 each, 4th, 4¼%	400.00
4 $100 bonds, Great Northern R. R., 5½%	400.00
2 $1000 bonds, Trenton Mort. and Title Guar. Co., 5½%, due 1937	2,000.00
2 $1000 bonds, Trenton Mort. and Title Guar. Co., 5½%, due 1938	2,000.00
1 $1000 bond, Denver Gas and Electric Light Co., 5%, due 1951	1,000.00
	$50,800.00

Respectfully submitted,
Albert B. Peck, *Treasurer*

REPORT OF THE EDITOR FOR 1930

The Editor read his report, and on motion it was accepted and ordered filed. The report follows:

To the Council, Fellows and Members of the Mineralogical Society of America: It would seem entirely proper to judge the achievements of the journal for the current year by the number and character of its articles, and by the size of the volume that has been issued. If this criterion be accepted the accomplishments of the *American Mineralogist* for 1930 must be considered as highly satisfactory, since on only one other occasion has a volume of approximately the same size been published.

Volume 15, which represents the current volume, contains about six hundred pages of text, which is an increase of one hundred pages when compared with Volume 14, and equals the outstanding record made in 1928. This attainment was brought about largely through the publication of another large special number issued in August which contained eleven articles and contributed 116 toward the grand total of 582 pages. The high total of two years ago can likewise be attributed to one unusually large issue. It would seem therefore, based upon past experience, that at the present time and under normal conditions volumes aggregating about 500 pages might be considered as representing more nearly the average size. However, on those occasions when special issues are offered new records are quite likely to be established.

An analysis of Volume 15 shows it to contain forty-seven leading articles that cover practically every phase of mineralogy. While it is rather difficult to classify accurately some of these articles as many are not confined to any one division, an attempt has however been made with the following results. Fifteen articles might be classified as falling within the realm of descriptive mineralogy, while fourteen place special emphasis upon chemical composition and hence have been assigned to the division of chemical mineralogy; ten deal with optical data or relate to crystal structure and have been included under physical mineralogy; three are purely of a crystallographic nature and five articles are of a miscellaneous character as they include addresses and memorials.

A general survey also shows that forty-two of these articles came from contributors within the States while five were received from Canada. During the past year forty-seven individuals representing twenty-five different universities, research bureaus and technical laboratories have contributed one or more leading articles, and the space devoted to these articles constitutes 86.2 per cent of the total space of the journal.

One rather unique feature of Volume 15 is the unusually large number of new mineral species described in detail for the first time: eleven new minerals, of which eight are phosphates. This establishes a record for our journal for any one year period.

Aside from the forty-seven leading articles fourteen additional shorter contributions were submitted that have been incorporated under the division of "Notes and News," thus increasing the total number of articles published to sixty-one and the number of contributors to sixty.

As in the past the *Mineralogist* has devoted considerable space to record brief items of interest, book reviews, abstracts of new species described in foreign journals and the proceedings of five mineralogical societies. In the current volume approximately eighty pages have been devoted to the items just enumerated. The journal has also been very profusely illustrated as is shown by the 156 illustrations distributed throughout the text.

Four years ago it was found necessary to reprint the first five volumes of the journal to meet the urgent demand for complete sets. This venture was a financial success as the returns have already exceeded the actual total cost of reproduction. It is interesting to note in this connection that approximately $300 is realized annually from the sale of back numbers and it seems logical to believe that this source of revenue will continue. These facts are mentioned as serious inroads have been made in the surplus copies of volume 6 (1921) and very shortly it will be necessary for the Council to authorize the reprinting of that volume. The approximate cost for two hundred copies has been estimated at $225.

A year ago considerable delay was experienced by the publishers in printing and distributing authors' reprints. I am pleased to report that with the installation of a new press this difficulty has been remedied and that reprints are now available within a period of thirty days after the appearance of the article.

In conclusion one suggestion might be offered which if put into effect should stimulate still greater interest in the journal. This suggestion relates to the number of free reprints furnished the authors. At present the Society is financially responsible for fifty reprints of each article. The number could be doubled with only a moderate increase in cost to the Society. I am sure this action would be welcomed by all our contributors and might even have the effect of attracting additional manuscripts.

The concluding table of contents summarizes the distribution of subject matter in Volume 15.

DISTRIBUTION OF SUBJECT MATTER IN VOLUME 15

Subjects		*Articles*	*Pages*	*Per cent of Total*
Leading articles				
Descriptive mineralogy	15			
Chemical mineralogy	14			
Physical mineralogy	10			
Crystallography	3			
Addresses, memorials, etc.	5			
		47	501½	86.2
Proceedings of societies		25	30	13.8
Notes and news		45	33	
Book reviews		14	8	
Abstracted accounts of new mineral names		31	9½	
Total of text		162	582	100.0
Illustrations		156		
Covers, advertisements, index			120	
Total			702	

Respectfully submitted,

WALTER F. HUNT, *Editor.*

REPORT OF THE NEW COMMITTEE ON NOMENCLATURE AND CLASSIFICATION OF MINERALS

W. T. Schaller, Chairman, read the report which follows:

The Committee on Nomenclature and Classification held two long sessions yesterday, December 28, 1930, all members being present except E. T. Wherry. The committee unanimously reached some conclusions and left others in abeyance for future consultation with a similar committee of the Mineralogical Society of Great Britain and Ireland. A full report will be sent to each member of our Society and to the English committee for future action, and for acceptance or rejection by this Society next December.

The committee asks that it be continued.

W. T. Schaller, *Chairman*
W. F. Foshag
E. S. Larsen
J. F. Schairer
T. L. Walker
A. N. Winchell

It was moved, seconded and carried that the committee be continued.

REPORT OF THE REPRESENTATIVE ON THE NATIONAL RESEARCH COUNCIL

The representative of the Society, W. T. Schaller, read the following report:

At the annual meeting of the National Research Council, held May 3, 1930, the following reports submitted are those of special interest to our Society.

1. Committee on potash-soda feldspar. Reports progress, especially in the application of spectroscopic chemical analysis.

2. Committee on clay minerals. Made substantial progress, completing work on kaolin minerals, full report of which is being published as a professional paper by the U. S. Geological Survey. Preliminary note on dickite, a new kaolin mineral, was published in the January (1930) number of the *American Mineralogist.* Fifty new analyses on carefully selected and studied material are now available.

3. Committee on measurement of geologic time by atomic disintegration. Submitted an eleven page report with an appendix of thirteen additional pages, a total of twenty-four pages giving a remarkably complete and exhaustive review of the work done on this subject for the last year.

4. Committee on processes of ore deposition: Subcommittee on criteria of paragenesis of ore minerals. Completed their task and assembled a report, with numerous illustrations, entitled: "On Criteria of Age Relations of Minerals, with Especial Reference to Polished Sections of Ores."

NEW BUSINESS

It was moved by Dr. Winchell that a committee be appointed to investigate the question of a medal to stimulate interest in the work of the Society. This was seconded and carried, and the President appointed E. H. Kraus, A. N. Winchell and E. S. Larsen.

It was moved by Dr. Schaller that a committee be appointed to co-operate with the Secretary of the XVI International Geological Congress which meets in Washington in 1932, along the lines of mineralogy and petrology. This was seconded and carried, and the President appointed W. F. Foshag, W. T. Schaller and J. F. Schairer.

According to a suggestion in the Editor's report, Dr. Phillips moved that one-hundred reprints be given to authors of leading articles appearing in the *American Mineralogist* instead of fifty as at present. This was seconded and carried.

MEMORIAL BIOGRAPHIES

In view of the fact that none of the authors of the memorial biographies were present, and also that the articles will be printed in full in this issue of the Journal, it was moved and carried that they be read by title. They were as follows:

Memorial of A. R. Crook (died May 30, 1930), by A. J. Walcott.
Memorial of L. McI. Luquer (died January 30, 1930), by P. F. Kerr.
Memorial of F. A. Wilder (died March 8, 1930), by J. J. Runner.

PRESENTATION OF PAPERS

At 2:50 P.M., there being no further business, the Society proceeded to the reading of scientific papers. The papers presented with short abstracts follow:

W. T. SCHALLER: *The Chrysocolla Group.* The name chrysocolla should be restricted to a group name, like mica, feldspar, and should not be applied to a single species. The chrysocolla group comprises the green and blue hydrous copper silicates. Two well defined and described "chrysocollas" require new names. A third new "chrysocolla" occurs at Bisbee, Arizona. About eight distinct species are placed in the chrysocolla group, including bisbeeite, cornuite, dioptase, plancheite, and shattuckite. Many specimens labelled chrysocolla are not single species but are mixtures of several substances, including silica, iron oxide, and manganese oxide.

E. POSNJAK AND N. L. BOWEN: (Presented by N. L. Bowen). *New Light on the Rôle of Water in Simple Amphiboles.* A peculiar, porcelain-like product frequently obtained from dry melts of the composition $MgSiO_3$ has hitherto been regarded as pure magnesian amphibole, kupfferite. This conclusion has tended to support the idea that water is not essential to the make-up of an amphibole. X-ray photographs show that the supposed amphibole is a submicroscopic intergrowth of forsterite (Mg_2SiO_4) and glass.

A further study of water in amphiboles was made by observing the changes produced in tremolite upon heating. It has been claimed that tremolite loses water on heating without significant change of optical properties and apparently without loss of its amphibole structure. We find that loss of water is accompanied by distinct changes in optical properties, and x-ray study shows that the amphibole structure is completely destroyed, giving place to a pyroxene structure. The essentially hydrous character of tremolite is thus proved and the detailed results are in strong confirmation of Schaller's definite formula, $Ca_2Mg_5H_2(SiO_3)_8$.

J. W. GREIG, E. POSNJAK AND H. E. MERWIN: (Presented by J. W. Greig). *On $Fe_2O_3-Fe_3O_4$ Solid Solutions.* A brief review of the data on which previous investigators have based their opinions as to the existence or non-existence of solid solutions of Fe_2O_3 and Fe_3O_4, and a description of some experiments designed to check the earlier work. Illustrated with photomicrographs of structures due to oxidation, reduction, and unmixing.

J. F. Schairer: *Crystallization in the System, $Na_2O-Fe_2O_3-SiO_2$.* As a consequence of the incongruent melting of acmite (aegirite) $Na_2O \cdot Fe_2O_3 \cdot 4SiO_2$ and the shape of the hematite-acmite boundary curve in the system, $Na_2O-Fe_2O_3-SiO_2$, very interesting crystallization paths result. By fractional crystallization of certain mixtures widely different mineral assemblages may result, depending upon the amount of fractionation. The mode of origin of certain mineral assemblages should be of great interest to the mineralogist and petrographer.

A new compound, $5Na_2O_3 \cdot Fe_2O_3 \cdot 8SiO_2$, appears as a crystalline phase. This compound may occur in certain types of alkalic rocks, but has not yet been found in nature.

* * * * *

At 3:57 P.M., the Society adjourned to attend a joint session with the Geological Society of America at 4:00 P.M. before which the presidential address of Dr. Herbert E. Merwin on "Some Associations of Ore Minerals" was given. This paper is published in full in this number. Following this address with H. E. Merwin presiding, papers of the Geological Society of a mineralogical and petrographic nature were presented. The joint session adjourned at 5:25 P.M.

On Tuesday, December 30, at 9:20 A.M., President Merwin called the second session of the Society to order, and the reading of papers proceeded according to program.

M. L. Huggins and G. O. Frank: (Presented by M. L. Huggins). *The Crystal Structure of Potassium Dithionate*, $K_2S_2O_6$. Potassium dithionate crystallizes in the trigonal trapezohedral class of the hexagonal system. An x-ray study, using the oscillating crystal method, shows the space group to be D_3^1, the dimensions of the unit cell, containing three "molecules," being $a_0=9.8$Å and $c_0=6.45$Å. The sulfur atoms are in pairs on the three-fold symmetry axes. From the intensities of the reflections approximate values of the parameters determining the positions of all of the atoms have been obtained.

Some measurements were also made on rubidium dithionate, $Rb_2S_2O_6$. It has a unit cell, also containing three molecules, with the dimensions, $a_0=10.0$Å and $c_0=6.45$Å. In all probability it is isomorphous with the potassium compound.

M. L. Huggins: *Principles Determining the Arrangements of Atoms and Ions in Crystals.* Practically all known arrangements of atoms in crystals can be accounted for on the basis of a few simple principles, such as the following: (1) Interatomic forces decrease rapidly with distance. (2) Like atoms tend to be surrounded similarly. (3) There is a tendency toward neutrality, in both large and small regions; hence negative ions tend to be surrounded by positive, and vice versa. (4) The number of atoms B which can stably exist around a given atom A is limited by the relative magnitudes of the forces between A and B and between B and B; it can conveniently be considered as determined by the relative sizes of A and B. (5) Atoms or ions with spherical or nearly spherical force fields tend to form as close-packed structures as possible, consistent with the foregoing principles. (6) The number of electron pairs in the valence shell of an atom is limited by their mutual repulsion; for electronegative atoms it is usually four. (7) Atoms frequently complete their valence shells by sharing electron pairs with other atoms. (8) The valence electron pairs in electronegative atoms tend to be as close as possible to the surrounding positive atoms. (9) Atoms and ions can be given relative dimensions which are approximately constant for a given element in similar environments.

L. S. Brown: *Euhedral Quartz Crystals and Quartz Rosettes from Salt Dome Cap Rock Anhydrite.* In dissolving cap rock anhydrite, euhedral quartz crystals have been noted before as residuals by Dr. Goldman of the U.S.G.S. The author has recently observed these quartz crystals in thin sections of anhydrite, and found them to be present as inclusions within anhydrite crystals, thus being older than the latter. This, with the absence of any earlier or detrital markings, seems to indicate direct crystallization from the sea.

A unique and beautiful structure is the rosette, in which crystals with perfect terminations radiate in all directions from a center or kernel of pure sulphur. First observed in thin section, these have since been obtained by solution of the anhydrite. They are quite constant in size, averaging 0.25 mm. in diameter, with the sulphur core about 0.06 mm.

These quartz crystals and rosettes are important for several reasons: (1) They constitute one evidence of the primary origin of the anhydrite by direct precipitation from the sea. (2) The existence of free sulphur prior to the crystallization of the anhydrite is demonstrated. (3) Their presence in the secondary calcite cap shows its origin by direct alteration of the anhydrite. (4) Their primary crystallization in this case indicates a similar origin possible for those quartz crystals so common in gypsum deposits elsewhere.

W. T. Schaller: *Ammonioborite, A New Mineral.* Ammonioborite is probably more abundant at Larderello, Tuscany, Italy, than larderellite, as four out of six specimens examined are ammonioborite. Its formula is $(NH_4)_2O \cdot 5B_2O_3 \cdot 5H_2O$. The formula of larderellite is either the same or $(NH_4)_2O \cdot 4B_2O_3 \cdot 4H_2O$. Optically the two minerals are readily differentiated, ammonioborite not occurring in the characteristic sharply defined rhombs of larderellite and having indices: $\alpha = 1.470$, $\beta = 1.487$, $\gamma = 1.540$, those of larderellite being $\alpha = 1.493$, $\beta = 1.52 \pm .01$, $\gamma = 1.561$. Neither mineral has been made artificially whereas the 1:5:8 salt, easily obtained by mixing boric acid and ammonia, has not been found in nature.

W. T. Schaller: *Crystals of Sulvanite.* Crystals of the rare mineral sulvanite, Cu_3VS_4, from Utah are isometric, being cubes with small faces of the rhombic dodecahedron and the octahedron. Chemically, sulvanite contains copper, vanadium, and sulphur, and may be considered the vanadium analogue of enargite. Crystallographically it is different, enargite being orthorhombic.

C. S. Ross, E. P. Henderson and E. Posnjak: *Clarkeite, a New Uranium Mineral.* (Presented by C. S. Ross). Specimens of uranium ores from Spruce Pine, North Carolina, commonly show a zonal arrangement of minerals. The central core is uraninite; this is surrounded by a zone of very dark brown material with pitchy luster; this by orange red gumite; and the outermost zone is lemon yellow uranophane. The dark brown mineral proves to be a new mineral with distinct chemical, optical and x-ray properties. This has probably been previously assumed to be impure gumite, although its optical properties are different from those given for gumite and are much more definite than for any gumite secured from Spruce Pine. It is proposed to name this new mineral clarkeite after Professor Frank W. Clarke. The composition is $RO \cdot 3UO_3 \cdot 3H_2O$ in which R is chiefly alkalies and lead.

A. F. Rogers: *Castanite, a Basic Ferric Sulfate from Knoxville, California.* The status of castanite, a basic ferric sulfate, described from Sierra Gorda, Chili, by Darapsky in 1890, is in doubt. Specimens recently obtained from the old Redington or Boston quicksilver mine at Knoxville, Napa County, California, furnish results which indicate that castanite is a valid mineral species with the formula $Fe_2O_3 \cdot 2SO_3 \cdot 8H_2O$. It is triclinic. Axial elements, indices of refraction, and pleochroism are given. The mineral occurs in a much altered impure gray opal which in turn is an alteration of serpentine. It is probably of solfataric origin.

W. F. Foshag: *A New Sulfate of Iron and Potash from California.* From a large pocket of sulfates of iron found in some cherts at Borate, San Bernardino County, California, there was collected among other sulfates of iron, a mineral occurring in clear green monoclinic crystals. This has proven to be a new mineral, a hydrous sulfate of iron and potash which is named krausite in honor of Professor E. H. Kraus of the University of Michigan and first president of this Society.

Stephen Richarz. *Contact metamorphism of the Pre-Cambrian formations near Mellen, Wisconsin.* In the Penokee Iron Range near Mellen, Wisconsin, the original sideritic cherts have been metamorphosed into amphibole-magnetite rocks. The amphiboles, formerly designated as actinolite, are now on the basis of optical properties differentiated as ten varieties with β varying from 1.621 to 1.692. Towards the east amphiboles are absent from the iron formation and mica is found in fibers and sheaf-like aggregates. Still farther east unmetamorphosed ferruginous cherts prevail.

Above the iron formation lies the Tyler slate, also highly metamorphosed towards the west. Van Hise and Leith ascribed the metamorphic effect to the gabbro which in the west is close to the iron formation and cuts the Tyler slate, while in the east it is more distant from both. In this paper it is shown that a granite intrusion in the gabbro has been more active in producing changes than the gabbro. The gabbro is cut by veins and large dikes of granite. The metamorphism of the gabbro begins with the formation of pale green rims of amphibole around pyroxene. In a more intense stage of metamorphism the amphibole replaces all of the pyroxene. The plagioclase, at first without visible alterations, becomes in a later stage filled with sericite, epidote minerals and a basic core of 50–60 percent An. is rimmed with a plagioclase of about 25 percent An. A complete change to albite was not observed, nor is there any complete assimilation of the gabbro by the granite.

J. H. C. Martens: *Persistence of Feldspar in Beach Sand.* Microscopic analyses of many samples show that the ratio of potash feldspar to quartz in the beach sand of the Atlantic coast varies from 0.062 near Charleston, South Carolina, to 0.001 at Miami, Florida. The feldspar content of the sand decreases with increasing distance southward from the original source in the Piedmont region. Examination of sands of different textures, and of coarse and fine portions of the same sand show that there is more feldspar in the fine sand than in the coarse. The large decrease in feldspar toward the south is due in part to the greater coarseness of the sand on the southern part of the east coast of Florida.

K. K. Landes: *A Paragenetic Classification of the Magnet Cove Minerals.* The Magnet Cove intrusive complex is elliptical in plan with a maximum diameter of about 15,000 feet. The peripheral intrusives through differential erosion have formed a rim which makes the cove. The rocks are alkalic in composition and contain a large number of unusual minerals. Contact metamorphism of both sandstone and limestone country rock has caused further mineralization. Lastly, secondary minerals have been formed through weathering processes. The minerals are further classified in each primary group according to paragenesis.

D. W. Trainer, Jr.: *"Zebra Rock" from Western Australia.* This peculiarly banded, highly quartzose rock of lower Cambrian age, which occurs in East Kimberley, Western Australia, is described both megascopically and microscopically. Theories regarding the origin of the rock itself and the interesting banding are postulated.

A. F. Rogers: *Granite Pegmatite from Salt Creek, Tulare County, California.* The striking feature of this pegmatite is the large size (up to 12 cm.) euhedral crystals of oligoclase of peculiar habit (110 and $1\bar{1}0$ are almost lacking).

The associated minerals are microcline, smoky quartz (up to 20 cm.), schorlite (black tourmaline), graphic granite, and altered muscovite.

The oligoclase shows both albite and pericline polysynthetic twinning and from the angle of the rhombic section it is judged to be about Ab_6An_1.

The oligoclase is a replacement of microcline. This is proved by the quartz relicts of the graphic granite in hand specimens of the oligoclase and by the microcline relicts in thin sections in the oligoclase.

A. C. Lane: *Philosophic Classifications of Mineral Structures.* Various terms applied to mineral aggregates, habits, growth and structure may perhaps be classified philosophically around the dominant directions (remembering that the degree of dominance is less and there is a tendency to higher symmetry the slower the growth and the higher the temperature. The importance of centers of crystallization relative to velocity of crystallization should also be regarded) as follows:

1. (a) One dominant direction (a) of greatest growth (and atomic crowding): prismatic cleavage? Silky luster? Structures such as a circular capillary filiform; aggregates about rare centers; stellated, etc.
    (b) One dominant direction (b) of least growth (and atomic crowding): basal or clinopinacoidal cleavage, pearly luster, structures such as foliated, tabular; aggregates such as concentric, orbicular, etc.
2. One dominant direction of greatest growth and one of least growth: structures such as bladed, lath shaped; aggregates such as sheaflike, plumose.
3. No one or two dominant directions, equidimensional, commonly isometric, (a) with three equal directions
    A. Not at right angles, rhombohedral habit
    B. At right angles, cubic, octahedral or dodecahedral cleavages.

W. T. Schaller: *The Crystallography of Kornelite.* A second locality of this rare hydrous ferric sulphate is the Tintic Standard mine, Utah. The crystals show two kinds of terminations: (1) normal forms of simple indices, all included in the unit rectangle of the gnomonic projection, (2) very steep corrosion pyramids, with indices like (12.6.1) and $(\bar{1}4.7.1)$, most of which are inclined less than 20° to the prism zone. These steep forms are derived from the normal terminal forms, to which they show crystallographic relation, by solution. The faces of the steep forms have a high luster but are broken, striated and rounded, and reflect many signals.

At 12:10 P.M., Dr. W. F. Hunt moved to adjourn until 2:00 P.M. This action was explained as being due to the small attendance and the fact that the program could probably be completed early in the afternoon. The motion was seconded and carried.

President Merwin called the third session of the Society to order at 2:10 P.M., and the reading of papers was resumed according to program.

GILBERT GREENWOOD (introduced by A. L. Parsons), read by Q. D. Singewald: *Optical Properties of Triphenylbismuthine Dichloride, an Example of Crossed Axial Dispersion.* Triphenylbismuthine dichloride, $(C_6H_5)_3BiCl_2$, crystallizes in colorless orthorhombic crystals. The face development is holoaxial. Etch figures also are in agreement with holoaxial symmetry. The acute bisectrix is the *b* axis. The axial planes are (001) and (100), the dispersion being strong. The wave length for which the crystal is uniaxial, varies with the temperature according to a straight line law. When the (010) face is viewed in parallel polarized light and brought into the extinction position, it does not extinguish but transmits light green in color. This is probably the result of rotatory polarization.

A. F. ROGERS: *The Nomenclature of Geometrical Crystallography.* Attention is called to the great variety of terms used in geometrical crystallography. A uniform system of nomenclature is greatly to be desired. Instead of working out a new set of names, the writer presents arguments in favor of Fedorov's names of forms based upon geometry, and of Groth's names of classes based upon the name of the general form (with simplification in the isometric system), and six crystal systems instead of seven. Names referring to merohedrism are discarded since crystal classes and not crystal systems are fundamental.

A. F. ROGERS: *Structural Crystallography.* For the science concerned with the internal structure of crystals, various terms such as leptonology, leptology, stereochemistry of the solid state, new or modern crystallography, and *x*-ray crystallography have been used.

For this important branch of science I propose the name *structural crystallography* co-ordinate with geometrical, physical and chemical crystallography. Attention is called to some of the important events in the development of structural crystallography. It is not generally recognized that there are seven primary space lattices. These, however, cannot be made the basis of crystal systems.

L. S. RAMSDELL: *The Identification of Psilomelane by Means of its Physica Properties.* Although there is considerable doubt as to the true composition of psilomelane, there are certain physical properties which are usually attributed to it. Important among these are the smooth botryoidal, reniform or stalactitic surfaces, and a hardness of 5–6. A study of the *x*-ray diffraction patterns from a large number of specimens of psilomelane shows that its identification by means of physical properties is uncertain, and cannot always be relied upon.

JOHN W. GRUNER: *A Simple Device for the Application of Differential Pressures in Experiments on Hydrothermal Mineral Alteration.* In order to reproduce natural conditions under which changes take place, as for example from pyroxene to hornblende, differential pressure besides a hydrothermal environment seems to be necessary. A small cylinder of invar steel was used. A fragment of the mineral was placed between two semi-cylindrical blocks of copper and tightly fitted into the cylinder.

This apparatus was placed in a bomb containing various solutions and gases. Mr. R. C. Gebhardt in this manner succeeded in changing hypersthene to hornblende at 250°C.

WM. A. P. GRAHAM: *Optical and Chemical Notes on the Transformation of Green to Brown Hornblende.* The cause for the change of green hornblende to brown hornblende is shown by chemical analyses to be the result of the oxidation of ferrous iron. Experiments have been performed to determine the causes of the accompanying changes in optical properties. Evidence is presented to show that sufficient oxygen to oxidize the ferrous iron cannot be obtained through the dissociation of the combined water. *X*-ray diffraction pattern studies indicate that no structural changes take place in the hornblende in changing from a green to brown color.

H. W. MORSE AND J. D. H. DONNAY, introduced by A. F. Rogers: *Spherulite Optics.* (Presented by A. F. Rogers). 1. General. Artificial spherulites of slightly soluble substances can be obtained by slow diffusion in jellies. New forms are found: *e.g.*, barium carbonate gives both a positive and a negative sphere.

2. Optical. The spherulites are either isotropic or birefringent. Between crossed nicols, the latter show the *spherulitic black cross* and a series of *concentric colored rings* of equal retardation. The retardation increases from zero at the center to a maximum at about two-thirds of the radius from the center, then decreases from this maximum to zero at the periphery.

3. Experimental. The retardation R for successive rings is numerically determined; the diameter $2r$ of the spherulite and the radii $r \cdot \cos\phi$ of the colored rings are measured. The ratio $R/2r$, plotted against $\cos\phi$ for various rings, gives a curve which is independent of the size of the sphere.

4. Theoretical. The unit crystal is assumed to be uniaxial and is oriented with its optic axis along a radius. A beam of light, along a vertical path, traverses a multitude of crystals variously oriented. The total retardation is the sum of the individual retardations of the superimposed units.

In a first approximation, simple integration leads to the formula $R=2r\cdot(n_\gamma-n_\alpha)\cdot\phi\cdot\cos\phi$, in which: R=retardation of a ring with a radius $r\cdot\cos\phi$; $2r$=diameter of the spherulite; 2ϕ=angle at the center, subtended by a chord equal to the length of the vertical path of light through the sphere; n_γ and n_α=high and low refractive indices. The maximum retardation, $R_{\max}/2r=0.561\ (n_\gamma-n_\alpha)$, occurs for $\cot\phi=\phi$, at $\cos\phi=0.652$. This simplified solution holds for all substances and for both positive and negative forms. A more accurate solution, involving a new application of Legendre elliptic integrals, gives different curves for positive and negative spherulites.

The check between the experimental and theoretical curves is satisfactory even in the approximate solution; it is almost perfect in the more exact treatment.

E. S. LARSEN AND HARRY BERMAN (Presented by Harry Berman): *Composition of the Amphiboles.* From *x*-ray structural data the general formula already derived by Warren for several members of the amphibole group is shown to be valid for all members of the group. This general formula may be expressed as follows:

$$(\mathrm{Na, K, Li, Ca})_{2-3}(\mathrm{Mg, Fe^{II}, Fe^{III}, Al, Ti})_5\,(\mathrm{Al, Fe^{III}, Ti, Si})_8(\mathrm{O, OH, F})_{24}.$$

A. N. WINCHELL: *Further Studies in the Amphibole Group.* Using the new type formula for amphiboles derived by Warren from x-ray studies, an attempt is made to graph the relations between composition and optic properties in various parts of the amphibole group. The results are satisfactory in the anthophylite, cummingtonite and tremolite-actinolite series, but no solution has been found for the alkaline amphiboles, and only a partial solution for hornblende. The problem is complicated in the case of hornblende and pargasite by the large number of molecules which are independent variables and by the possibility of optical effects due to oxidation of ferrous iron.

E. P. HENDERSON AND F. L. HESS (Presented by E. P. Henderson): *Fervanite—A New Vanadium Mineral.* Fervanite is a fibrous golden yellow mineral occurring in the vanadium bearing rocks of southwestern Colorado and southeastern Utah. It is a hydrous iron vanadate with a formula $2Fe_2O_3 \cdot 2V_2O_5 \cdot 5H_2O$. Fervanite is found in the cracks in the dark colored oxides of vanadium and also as a thin coating on the sandstones. In all the specimens, so far found, fervanite is closely associated with gypsum.

The last paper was finished at 4:07 P.M. after which Dr. W. J. McCaughey moved that the thanks of the Society be extended to the authorities of the University of Toronto, to the local committee and to Mrs. D. A. Dunlap for their kindness and hospitality. This was seconded by Dr. A. F. Rogers and was unanimously adopted by a rising vote of those present. The Society then adjourned.

During the sessions of the Society, a total of twenty-nine scientific papers were presented, none being read by title. Ninety-five fellows, members and guests were present at the various meetings. The following registered at the meetings:

Adams, F. D.; Agar, W. M.; Allen, V. T.; Alling, H. L.; Bannerman, H. M.; Bascom, F., Miss; Bayley, W. S.; Beaton, H. S.; Berman, H.; Billings, M P.; Bowen, N. L.; Branner, G. C.; Brown, L. S.; Bruce, E. L.; Buddington, A. F.; Colburn, B. S.; Colburn, W. B.; Colony, R. J.; Cook, C. W.; Corbett, C. S.; Currier, L. W.; English, G. L.; Ferrier, W. F.; Fettke, C. R.; Foreman, F.; Foyles, E. J.; Foshag, W. F.; Fretz, A. H.; Fuller, R. E.; Furcron, A. S.; Gilluly, J.; Goddard, E. N.; Graham, R.; Graham, W. A. P.; Grawe, O. R.; Gruner, J. W.; Hawley, J. E.; Henderson, E. P.; Holland, S. S.; Howland, A. L.; Huggins, M. L.; Hunt, W. F.; Ichimura, T.; Jensen, D. E.; Jolliffe, F. T.; Kerr, P. F.; Kerr-Lawson, D. E.; Kerr-Lawson, Mrs. D. E.; Kraus, E. H.; Kraus, J. D.; Kunz, G. F.; Landes, K. K.; Landon, R. E.; Lane, A. C.; Larsen, E. S., Jr.; Lewis, J. V.; Lindgren, W.; Longley, C. S.; Lonsdale, J. T.; Martens, J. H. C.; Mathews, E. B.; McCaughey, W. J.; McNairn, W. H.; Mertie, J. B., Jr.; Merwin, H. E.; Miller, B. L.; Miller, V. B.; Moore, E. S.; Morton, J. F.; Osborne, F. F.; Parsons, A. L.; Peck, A. B.; Perkins, E. H.; Phillips, A. H.; Ramsdell, L. S.; Reavely, G. H.; Richarz, S.; Ries, H.; Rogers, A. F.; Ross, C. S.; Sampson, E.; Schairer, J. F.; Schaller, W. T.; Senstius, M. W.; Singewald, Q. D.; Slawson, C. B.; Spence, H. S.; Stow, M. H.; Stadnichenko, T., Miss; Thomson, E.; Tolman, C.; Trainer, D. W., Jr.; Van Horn, F. R.; Walker, T. L.; Winchell, A. N.

LIST OF FORMER OFFICERS AND MEETINGS, WITH DATES

By recommendation of the Council, a complete list of past officers is printed in the proceedings of the annual meeting of the Society.

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1929-1930	Albert B. Peck

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1925	Thomas L. Watson, Esper S. Larsen, Arthur L. Parsons, William F. Foshag
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1928	William F. Foshag, William A. Tarr, Alexander N. Winchell, Ellis Thomson
1929	William A. Tarr, Alexander N. Winchell, Ellis Thomson, Clarence S. Ross
1930	Alexander N. Winchell, Ellis Thomson, Clarence S. Ross, Paul F. Kerr

ANNUAL MEETING PLACES

1920	Chicago, Illinois
1921	Amherst, Massachusetts
1922	Ann Arbor, Michigan
1923	Washington, D.C.
1924	Ithaca, New York
1925	New Haven, Connecticut
1926	Madison, Wisconsin
1927	Cleveland, Ohio
1928	New York, New York
1929	Washington, D.C.
1930	Toronto, Canada

HONORARY LIFE FELLOWS OF THE MINERALOGICAL SOCIETY OF AMERICA

Becke, Friedrich J., University of Vienna, Austria.
Brauns, Reinhard, University of Bonn, Germany.
Brögger, Waldemar C., University of Oslo, Norway.
Friedel, A., University of Strassburg, Strassburg, Alsace, France.
Goldschmidt, Victor, University of Heidelberg, Heidelberg, Germany.
Lacroix, A., Museum of Natural History, Paris, France.
Rinne, Friedrich, Günterstal Freiburg in Baden, Germany.
Spencer, L. J., Natural History Museum, South Kensington, London, S. W. 7, England.

LIST OF FELLOWS AND MEMBERS OF THE MINERALOGICAL SOCIETY OF AMERICA[1]

(*Indicates Fellow).

*Adams, Elliot Q., Lamp Development Lab., Nela Park, Cleveland, Ohio.
Adams, George I., Dept. of Geology, University of Alabama, Tuscaloosa, Alabama.
Agar, William M., Dept. of Geology, Columbia University, New York City.
Ahlfeld, Friedrich, Marburg A/Lahn, Germany.
Aldridge, Curtece, 307 Elm St., Rome, New York.
Allen, Duncan G., c/o State Highway Dept., Langtry, Texas.
Allen, Frederick I., 55 East 65th St., New York City.
Allen, Fred M., Box 185, Gastonia, North Carolina.
Allen, Victor T., St. Louis University, 221 N. Grand Blvd., St. Louis, Missouri.
*Alling, Harold L., 901 East Ave., Rochester, New York.
Amilcar, Mario de Jesus, Institute Superior Tecnico, Lisboa, Portugal.
*Aminoff, Gregori, Riksmuseet, Stockholm 50, Sweden.
Anderson, Charles A., Dept. of Geology and Mineralogy, University of California, Berkeley, California.
Andersen, Olaf, Research Lab., U. S. Steel Corp., Kearny, New Jersey.
Andrews, Gerald, Dept. of Geology, Egyptian University, Cairo, Egypt.
Armstrong, L. K., 704 Peyton Bldg., Spokane, Washington.
Ashby, George E., 265 Washington Ave., Brooklyn, New York.
*Ashcroft, Frederick Noel, 1 Egerton Gardens, South Kensington, S. W. 3, London, England (Life Fellow).
Ayers, Vincent L., Michigan College of Mines and Technology, Houghton, Michigan.
Bailey, E. M., Andover, Maine.
Baker, J. Willard, R. F. D. No. 2, Box 8, Franklin, Massachusetts.
Balke, Claire C., ~~40~~ Deere Park Drive South, Highland Park, Illinois.
Ballintine, Robert, 133 Buckingham Rd., Upper Montclair, New Jersey.
Bannerman, H. M., Dartmouth College, Hanover, New Hampshire.

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[1] The names and addresses here listed are those on record January 1, 1931. Any omission or correction should be sent to the Secretary, Dr. Frank R. Van Horn, Case School of Applied Science, Cleveland, Ohio.

Bandy, Mark C., Chile Exploration Co., Chuquicamata, Chile, South America via Antofogasta.
Barrett, R. L., 1724 East 115th St., Cleveland, Ohio.
Barth, Tom., Geophysical Laboratory, Washington, D. C.
*Bascom, Miss F., R. F. D. No. 3, North Adams, Massachusetts.
Bauer, L. H., New Jersey Zinc Co., Franklin, New Jersey.
*Bayley, William S., Dept. of Geology, University of Illinois, Urbana, Illinois
Beery, G. P., 849 15th St. A., Moline, Illinois.
*Berman, Harry, 22 Bloomingdale St., Chelsea, Massachusetts.
Biglowe, W. E., 56 Beacon St., Boston, Massachusetts (Life Member).
Billings, Marland, 22 Burroughs St., Jamaica Plains, Massachusetts.
Birdsey, B. A., Creede, Colorado.
Blank, Eugene W., 241 North Ninth St., Allentown, Pennsylvania.
Blank, Horace R., 64 Lawrence Ave., Tuckahoe, New York.
Block, Arthur C., 2631 Yale Ave., Butte, Montana.
Blumenthal, Maurice, 558 Quincy St., Brooklyn, New York.
Boatner, H., 618 Landers Bldg., Springfield, Missouri.
*Bøggild, O., University of Copenhagen, Copenhagen, Denmark.
Boubée, Nerée, 3 Boulevard et Place St. Andre-des-Arts, Paris, France.
*Bowen, N. L., Geophysical Laboratory, Washington, D. C.
*Bowles, Oliver, Building Material Division, U. S. Bureau of Mines, Washington, D. C.
Bowling, J. H., Harrah, Washington.
Boyle, J. C., 223 Kenmore Road, Upper Darby P. O., Brookline, Pennsylvania.
Bradley, F. F., 2466 Broadway, Toledo, Ohio.
Bradley, J. W., 1219 Pacific Mutual Bldg., Los Angeles, California.
Brant, Arthur M., Lord Hall, Ohio State University, Columbus, Ohio.
Brendler, W., Chemisches Mineralogisches Laboratorium, Hamburg 23, Marientaler Str. 142, Germany.
Broadwell, W. H., 571 Hawthorne St., Newark, New Jersey.
Brock, Clarence L., P. O. Box 1492, Houston, Texas.
Brown, H. C., Lusk, Wyoming.
Brown, Levi S., University of Texas, University Station, Austin, Texas.
*Bruce, E. L., Dept. of Mineralogy, Queen's University, Kingston, Ontario, Canada.
*Buddington, Arthur F., Princeton University, Princeton, New Jersey.
*Buerger, Martin J., Room 4–346, Massachusetts Institute of Technology, Cambridge, Massachusetts.
*Burbank, Wilbur S., U. S. Geological Survey, Golden, Colorado.
Burrage, Albert C., 85 Ames Bldg., Boston, Massachusetts.
Burt, Frederick A., Faculty Exchange, College Station, Texas.
Butler, B. T., Room 316 Main Bldg., College of the City of New York, 139th St. and Convent Ave., New York City.
*Butler, G. M., Univ. of Arizona, Tucson, Arizona.
*Buttgenbach, Henry J., 439 Avenue Louise, Brussels, Belgium.

*Cahn, Lazard, 6 N. 8th St., Colorado Springs, Colorado.
Callahan, J. E., 21 Acre Lane, Brixton, London, S. W. 2, England.

Callahan, William H., Austinville, Virginia.
Campbell, Ian, Room 12, Geological Museum, Cambridge, Massachusetts.
Capps, Mrs. Washington L., 1823 Jefferson Place N. W., Washington, D. C.
Carhart, Miss Grace M., Hunter College, Park Ave., 268th St., New York City.
Carobbi, Guido, Institutio di Chimica Generale, R. Universita, Via Messocannone A, Naples, Italy.
Carpenter, George E., 920 Broad St., Newark, New Jersey.
Carpenter, Sidney, Box 99, Station A., Hartford, Connecticut.
Case, L. V., Washington Irving High School, Tarrytown, New York.
Chadbourn, E. R., 394 Pleasant St., Melrose, Massachusetts.
Cienkowski, Edmund H., 6803 Bustleton Ave., Philadelphia, Pennsylvania.
Clark, Ralph E. Jr., Reading Road and Linton St., Cincinnati, Ohio.
Clinton, Henry G., Box B, Manhattan, Nevada.
Codazzi, Ricardo L., P. O. Box 965, Bogota, Columbia.
Cohen, Herman, 333 Ovington Ave., Brooklyn, New York.
Colburn, Burnham S., Greystone Court, Biltmore, North Carolina.
Colburn, William B., 333 Washington Rd., Grosse Pointe, Michigan.
*Colony, R. J., Dept. of Geology, Columbia University, New York City.
Commod, Julius, Bagdad Copper Co., Hillside Arizona.
Connolly, J. R., 905 Columbus St., Rapid City, South Dakota.
Conover, Ramon, Box 35, Kyserike, Ulster Co., New York.
*Cook, C. W., Geological Lab., University of Michigan, Ann Arbor, Michigan.
*Corbett, Clifton S., The Gulf Companies, Room 719, 21 State St., New York City.
Craigie, D. E., 306 Windemere Ave., Swansea, Toronto, Ontario, Canada.
Crawford, Arthur L., 1067 East 5th St., South, Salt Lake City, Utah.
*Crawford, R. D., 1050 Tenth St., Boulder, Colorado.
Crosby, Thomas C., Mause, Sambro, Nova Scotia.
Cummins, A. B., 730 Park Ave., Plainfield, New Jersey.
Currier, L. W., 759 Comstock Ave., Syracuse, New York.
Curtis, Peter L., Skagga Springs, California.

Dake, H. C., 793½ Thurman St., Portland, Oregon.
*Dana, E. S., 24 Hillhouse Ave., New Haven, Connecticut.
Davidson, Stanley C., San Louis Mining Co., Cordova y Cia, Estacion Dimas, Sinaloa, Mexico.
de Clairmont, Adolph, 133 North Rosemont Ave., Los Angeles, California.
Diaz, Carlos A., Cassilla 60, La Serena, Chile.
Doak, Samuel E., 135 South 2nd St., Philadelphia, Pennsylvania.
*Dodge, Francis D., 69 Avenue A., Bayonne, New Jersey.
Doll, Charles G., 973 Douglas Ave., Providence, Rhode Island.
Donnay, J. D. H., Box 2393, Stanford University, California.
Doten, Robert K., 58 Garfield St., Cambridge, Massachusetts.

*Eakle, Arthur S., 207 Lewers Rd., Honolulu, Terr. Hawaii.
Eggleston, Julius W., Cuttingsville, Vermont.
Dr. Ehrenberg, Mineralogisches Institut, Planck Str. 14, Göttingen, Germany.
*Ellsworth, H. V., Geological Survey, Ottawa, Canada.
Elwell, Wilbur J., R. F. D. No. 4, Box 18, Danbury, Connecticut.

Emery, Alden H., U. S. Bureau of Mines, Washington, D. C.
Emmons, R. C., Science Hall, University of Wisconsin, Madison, Wisconsin.
Engel, Rene, California Institute of Technology, Pasadena, California.
*English, George L., 50 Brighton St., Rochester, New York.
Erickson, E. T., U. S. Geological Survey, Washington, D. C.

Fahey, J. J., U. S. Geological Survey, Washington, D. C.
Fairchild, J. G., U. S. Geological Survey, Washington, D. C.
Faust, G. T., 1520 West Susquehanna Ave., Philadelphia, Pennsylvania.
Fernquist, Charles O., Public Museum, 2316 1st Ave., Spokane, Washington.
*Fettke, Charles R., 1118 Wightman St., Squirrel Hill Station, Pittsburgh, Pennsylvania.
Fish, Henry G., Universal Portland Cement Co., Buffington, Indiana.
Fisher, D. Jerome, Dept. of Geology, University of Chicago, Chicago, Illinois.
Fisher, Lloyd W., Dept. of Geology, Bates College, Lewiston, Maine.
Flack, Wylie H., 4418 North 15th St., Philadelphia, Pennsylvania.
Flint, George M., 37 Mt. Vernon St., Boston, Massachusetts.
Ford, Hugh Alex, British Legation, Monrovia, West Africa.
*Ford, W. E., 876 Yale Station, New Haven, Connecticut.
*Foshag, William F., Division of Mineralogy, U. S. National Museum, Washington, D. C.
Fretz, A. H., 42 West Market St., Bethlehem, Pennsylvania.
Fuller, Richard E., 1642 Federal Ave., Seattle, Washington.
Furcron, A. S., Dept. of Geology, Western Reserve University, Cleveland, Ohio.

*Gage, R. B., Box 106, Trenton, New Jersey.
Gallagher, David, 361 Temple St., New Haven, Connecticut.
Galliher, E. Wayne, Jacques Loeb Lab., Hopkins Marine Station, Pacific Grove, California.
Gedney, Edwin K., 67 Fells Ave., Medford, Massachusetts.
Gehman, G. W., 248 Wall St., Bethlehem, Pennsylvania.
*Gillson, Joseph L., Room 8060 Dupont Bldg., Wilmington, Delaware.
Gilluly, James, U. S. Geological Survey, Washington, D. C.
Glass, Miss J. J., U. S. Geological Survey, Washington, D. C.
Gonyer, Forest A., Dept. of Mineralogy, Harvard University, Cambridge, Massachusetts.
*Gordon, Samuel G., Academy of Natural Sciences, Philadelphia, Pennsylvania.
Gordon, William Thomas, Kings College, Strand, London W. C. 2, England.
Goudey, Hatfield, 225 Montgomery St., San Francisco, California.
Graeber, Charles K., Pennsylvania Geological Survey, Harrisburg, Pennsylvania.
*Graham, R. P. D., McGill University, Montreal, Canada.
Graham, Wm. A. P., Geology Dept., Ohio State University, Columbus, Ohio.
Grawe, Oliver R., School of Mines and Metallurgy, Rolla, Missouri.
Green, Frank T., 1176 Fell St., San Francisco, California.
Greenland, C. W., Box 1242, Timmins, Ontario, Canada.
Gregory, Albert G. F., 139 Eulham Rd., So. Kensington, London, S. W. 3, England.
Greig, J. W., Geophysical Lab., 2801 Upton St., N. W., Washington, D. C.
Grenzig, J. G., 219 Lincoln St., Brooklyn, New York.

Grosholz, Gustave, Zasiusstrasse 30, Freiburg in Breislau, Germany.
Gross, Erwin F., 1169 E. 37th St., Brooklyn, New York.
*Gruner, John W., Dept. of Geology and Mineralogy, University of Minnesota, Minneapolis, Minnesota.
*Guild, Frank N., University of Arizona, Tucson, Arizona.
Gushee, Edward G., 5119 Green St., Germantown, Philadelphia, Pennsylvania.

Hall, F. P., 715 Crossett St., Syracuse, New York.
Hanley, Franklin B., 94 Central Ave., Newark, New Jersey.
Hammer, Alfred E., Malleable Iron Fittings Co., Branford, Connecticut.
Harada, Z., c/o Frau Freidheim, Heimhundert Strasse 26, Hamburg, Germany.
Harley, G. Towsend, Clifton, Arizona.
Harrison, H. C., Research Bldg., Westinghouse Electric and Mfg. Co., East Pittsburgh, Pennsylvania.
*Hawkins, A. C., 300 Livingston Ave., New Brunswick, New Jersey.
Hart, Gilbert, Dept. of Engineering, St. Edwards University, Austin, Texas.
Hart, W. C., 101 Ruxton St., Manitou, Colorado.
Harvey, Roger D., Cerro de Pasco Copper Co., Morococha, Peru.
Hawley, James E., Dept. of Mineralogy, Queen's University, Kingston, Ontario, Canada.
Heineman, Robert E. S., 1633 E. Hawthorne St., Tucson, Arizona.
*Henderson, Edward P., Dept. of Geology, U. S. National Museum, Washington, D. C.
*Hess, Frank L., U. S. Geological Survey, Washington, D. C.
Hesthal, C. E., 92 East Lakeview Ave., Columbus, Ohio.
*Hewett, Donnel Foster, U. S. Geological Survey, Washington, D. C.
Hills, Thomas McD., Dept. of Geology, Vassar College, Poughkeepsie, New York.
Hirsch, Dipl. Ing. Willy, Fürstenstrasse 22, I^e, München, Germany.
Hoadley, Charles, 145 Willow St., Brooklyn, New York.
Hodge, E. T., University of Oregon, Eugene, Oregon.
Holden, Guerdon S., Plain Dealer Bldg., Cleveland, Ohio. [Life Member].
Hollister, Robert B., 102 Meadowbrook Rd., Garden City, Long Island, New York.
Holmes, Arthur, Science Lab., South Road, Durham, England.
Holmes, Lindsey D., Room 1803, 27 William St., New York City.
*Honess, Arthur P., 113 Frazier St., State College, Pennsylvania.
Horn, Aubrey E., Loup House, Axminster, Devon, England.
*Hubbard, Lucius L., Houghton, Michigan.
Huggins, M. L., 600 Foothill Rd., Stanford University, California.
*Hunt, Walter F., Mineralogical Lab., University of Michigan, Ann Arbor, Michigan.
Hurst, George D., 322 W. 56th St., New York City.
*Hutchinson, Arthur H., Pembroke College, University of Cambridge, Cambridge, England.

*Insley, Herbert, Industrial Bldg., Bureau of Standards, Washington, D. C.
Irwin, Walter T., 311 Thompson St., Ann Arbor, Michigan.

Jacob, Walter P., 2445 Graybar Bldg., New York City.
Jacobs, Elbridge C., Univ. of Vermont, Burlington, Vermont.
Jenkins, Olaf P., 630 Amherst St., Palo Alto, California.
John, E. W., Clear Lake, Utah.
Johnson, J. Harlan, Box 343, Golden, Colorado.
*Johnston, R. A. A., 197 Bronson Ave., Ottawa, Canada.

Karaback, Hans, Hawslabgasse 7, Vienna, Austria.
Karlsson A., 265 E. 201st St., New York City.
Karpinsky, R. E., Manawa, Wisconsin.
Keller, J. Walter, 130 Walnut St., Philadelphia, Pennsylvania.
Keller, W. D., 815 South Jefferson St., Mexico, Missouri.
*Kerr, Paul F., Dept. of Mineralogy, Columbia University, New York City.
Kerr-Lawson, Mrs. Ferga C., Box 5, Swastika, Ontario.
King, Byron F., 232 Wagners Road, Morgantown, West Virginia.
*Klein, A. A., Norton Company, Worcester, Massachusetts.
Knabe, William C., 3853 N. Gratz St., Philadelphia, Pennsylvania.
Koenig, Robert P., No. 1, West 89th St., New York City.
Koschmann, A. H., U. S. Geological Survey, Washington, D. C.
Kôsu, S., c/o Maruzen Co., Koksubun-Machi, Sendai, Japan.
*Kôzu, S., Mineralogical and Petrographical Inst., Tohoku Imperial University, Sendai, Japan.
Krantz, F., Herwarthstrasse 36, Bonn, Germany.
*Kraus, Edward H., Mineralogical Lab., University of Michigan, Ann Arbor, Michigan.
Krieger, Philip, Dept. of Geology, Columbia University, New York City.
*Kunz, George F., c/o Tiffany and Co., 405 Fifth Avenue, New York City.

*Landes, Kenneth K., Geology Dept., University of Kansas, Lawrence, Kansas.
Landon, Robert E., U. S. Geological Survey, Golden, Colorado.
*Lane, Alfred C., 222 Arlington St., Cambridge, Massachusetts.
*Larsen, Esper S., 59 Orchard St., Belmont, Massachusetts.
Lausen, Carl, 420 N. Vine St., Tuscon, Arizona.
Lee, H. T., Dept. of Geology, College of Science, National Central University, Nanking, China.
*Lee, O. Ivan, 2684 Boulevard, Jersey City, New Jersey.
Lemcke, W. L., 609-14th St., Franklin, Pennsylvania.
Leonard, R. J., Dept. of Geology, University of Arizona, Tuscon, Arizona.
Leoni, N. M., Lemoore, California.
*Lewis, J. Volney, The Gulf Companies, Room 719, 21 State St., New York City.
Lind, J. C., Weber College, Ogden, Utah.
*Lonsdale, John T., Dept. of Geology, Agricultural and Mechanical College, College Station, Texas.
*Louderback, G. D., Dept. of Geology, University of California, Berkeley, California.

*Manchester, James G., 34 Nassau St., New York City.
Manley, J. A., 132 Hamilton St., New Brunswick, New Jersey.
Mantle, J. G. C., 111 Ames Ave., Leonia, New Jersey.

Martens, James H. C., 232 Wagner Rd., Morgantown, West Virginia.
*Mathews, E. B., Dept. of Geology, Johns Hopkins University, Baltimore, Maryland.
Maynard, Ernest A., 161–41, 86th Ave., Jamaica, New York.
*McCaughey, William J., Lord Hall, Ohio State University, Columbus, Ohio.
McClung, Esther C., 145 Louise St., Atlanta, Texas.
McCoun, H. D., Box 424, Lander, Wyoming.
McIntosh, Franklin G., 1520 Liberty St., Franklin, Pennsylvania.
McKinstry, Hugh E., Hollinger Gold Mines, Ltd., Timmons, Ontario, Canada.
McLaren, A. L., Forest Lodge, Box 20, Perth, Ontario.
McLellan, Roy D., 24 Lillian Terrace, Woodbridge, New Jersey.
McNairn, W. Harvey, McMaster University, Hamilton, Canada.
Melhase, John, 675 Vincente Ave., Berkeley, California.
Mertie, J. B., Jr., U. S. Geological Survey, Washington, D. C.
*Merwin, Herbert E., Geophysical Lab., Washington, D. C.
Miller, Clarence E., 7 Norwood Ave., Edgewood, Rhode Island.
*Miller, Benjamin L., Lehigh University, South Bethlehem, Pennsylvania.
*Miller, William J., Dept. of Geology, University of California, Los Angeles, California.
Minami, Eiichi, 2035 Uchigoshi, Nakano Machi, (Near Tokyo), Japan.
Mitchell, Edward R., 2131 South Primrose Ave., Alhambra, California.
Montgomery, Arthur, 111 East 56th St., New York City.
*Moore, E. S., Dept. of Geology, University of Toronto, Toronto, Canada.
Morey, Philip S., 713 Missouri Ave., Columbia, Missouri.
Morgan, Leonard A., 216 Jones Ave., Burlington, New Jersey.
Morgan, L. P., U. S. Assay Office, New York City.
Morse, Samuel F., 237 Locust St., Danvers, Massachusetts.
Morton, James F., Paterson Museum, Paterson, New Jersey.
Murphy, Richard, Dome Mines Club #1, South Porcupine, Ontario, Canada.

Nemoto,Tadahiro, c/o Rigakubu Chi Skitsugaku Kyoshitsu, Hokkaido Teikoku Daigaku Sapporo, Hokkaido, Japan.
Newcomet, William S., 3501 Baring St., Philadelphia, Pennsylvania.
*Newhouse, W. H., Dept. of Geology, Room 4–348, Massachusetts Institute of Technology, Cambridge, Massachusetts.
*Niggli, Paul, Eidgenössische Technische Hochschule, Zürich, Switzerland.
Noble, James A., Cerro de Pasco Copper Corp., Oroya, Peru, South America.
Nolan, Thomas B., U. S. Geological Survey, Washington, D. C.
Noording, K. L., Vischmarket 23, Groningen, Holland.
Nutting, P. G., U. S. Geological Survey, Washington, D. C.

Okada, I., c/o Faculty of Science, Tokyo Imperial University, Hongo, Tokyo, Japan.
Okamato, Yohachiro, 1 Chrome, Yamashita-Cho, Karatsu-Machi, Saga-Ken, Japan.
Oldach, F. M., 323 Wellesley Rd., Philadelphia, Pennsylvania.
Olmstead, Frank R., 356 Morgantown St., Uniontown, Pennsylvania.
*Orcel, Jean, Museum d'Histoire Naturelle, 61 Rue de Buffon, Paris, France.
Over, Edwin J., Jr., Y. M. C. A., Colorado Springs, Colorado.

Pabst, Adolf, Dept. of Geology, University of California, Berkeley, California.
Pacini, A. J., 9 South Clinton St., Chicago, Illinois.
*Palache, Charles, 106 Appleton St., Cambridge, Massachusetts. [Life Fellow].
Palm, John, Box 134, Lakeside, Michigan.
Palmer, E. C., 5608 14th St., Washington, D. C.
Palumbo, Roberto, 2 via Gerolama Fracastoro, Rome, Italy.
Papish, Jacob, Dept. of Chemistry, Cornell University, Ithaca, New York.
Paquette, Walter J., 253 Worthington St., Toledo, Ohio.
*Parker, Robert L., Swiss Federal Technical University, Zürich, Switzerland.
*Parsons, A. L., Dept. of Mineralogy, University of Toronto, Toronto, Canada.
Peacock, Martin A., University of British Columbia, Vancouver, B. C.
*Peck, Albert B., Mineralogical Lab., University of Michigan, Ann Arbor, Michigan.
Peck, Harry S., 472 Broadway, Albany, New York.
Pegau, Arthur A., University of Virginia, Charlottesville, Virginia.
Perkins, Edward H., Colby College, Waterville, Maine.
Perry, Charles W., 86 Highland Ave., Greenfield, Massachusetts.
Perry, Elwyn L., Dept. of Geology, Williams College, Williamstown, Massachusetts.
Pfordte, Otto F., Cairo, Greene Co., New York.
Pitts, William B., Sunnyvale, California.
*Phillips, Alexander H., 54 Hodge Rd., Princeton, New Jersey.
Pohndorf, Arthur G., 400 17th St., Denver, Colorado.
Poindexter, O. Floyd, Michigan Geological Survey, Lansing, Michigan.
*Poitevin, Eugene, Geological Survey, Ottawa, Canada.
Porter, Duportal D., 806 Lane Blvd., Kalamazoo, Michigan.
Pough, Frederick H., 4 Lenox Place, St. Louis, Missouri.
Purdin, W. C., Box 25, Pori, Oxford, Oregon.

*Ramdohr, Paul, Technische Hochschule, Aachen, Germany.
*Ramsdell, Lewis S., Mineralogical Lab., University of Michigan, Ann Arbor, Michigan.
Reamer, Louis, 482 Lincoln Ave., Orange, New Jersey.
Renshaw, John P., Hollister, San Benito Co., California.
*Richardson, C. H., Syracuse University, Syracuse, New York.
Richardson, Lee T., U. S. Geological Survey, Washington, D. C.
*Richarz, Stephen, St. Mary's College, Techny, Illinois.
Ridlon, Hugh W., Cuttingsville, Vermont.
*Ries, H., Dept. of Geology, Cornell University, Ithaca, New York.
Ries, Minette, Phillips Petroleum Co., San Angelo, Texas.
*Rogers, Austin F., Stanford University, California.
*Ross, Clarence S., U. S. Geological Survey, Washington, D. C.
Rosicky, V., Univ. Masaryk's Brno, Kounicova 59, Republic Czecho-Slovakia.
*Runner, J. J., Old Science Bldg., University of Iowa, Iowa City, Iowa.
*Russell, A. E., Swallowfield Park, Reading, Berks., England.
Russ, William J. C., 4118–75th St., Jackson Heights, Long Island, New York.
Rutherford, Ralph L., Dept. of Geology, Univ. of Alberta, Edmonton, Alberta, Canada.

*Sampson, Edward, Dept. of Geology, Princeton, New Jersey.
Schaefer, Eugene, Maywood Chemical Co., Maywood, New Jersey.
*Schairer, J. F., Geophysical Lab., 2801 Upton St., Washington, D. C.
*Schaller, Waldemar T., U. S. Geological Survey, Washington, D. C.
Schernikow, Ernest, 2240 Hyde St., San Francisco, California.
Schierecke, Theodore H., 1034-72nd St., Brooklyn, New York.
Schmid, Edward R., 267 Bloomfield Ave., Verona, New Jersey.
*Schneider, Hyrum, University of Utah, Salt Lake City, Utah.
*Schneiderhöhn, Hans, Mineralogisches Institut der Univeristät Freiburg, Burgunderstrasse 30, Freiburg, Germany.
*Shoep, Alfred, Dept. of Mineralogy, University of Ghent, Ghent, Belgium.
*Schrader, Frank C., U. S. Geological Survey, Washington, D. C.
Schulz, George E., 400 Elm St., Calumet, Michigan.
Senstius, Maurits W., Dept. of Geology, University of Michigan, Ann Arbor, Michigan.
Shipton, T. D., Hanover, Illinois.
Shone, T. L. H., P. O. Box 20, Postmasburg, Hay, South Africa.
*Short, Max N., U. S. Geological Survey, Washington, D. C.
Simondetti, Luigi, via Carlo Alberto 38, Turin, Italy.
*Simpson, Edward S., Government Lab., Wellington St., Perth, Western Australia.
Skea, E. M., P. O. Box 46, Pilgrims Rest, Transvaal, South Africa.
Slabodnik, Mark, 1018 South Alder St., Tacoma, Washington.
Slack, Floyd W., Edison Ave., Ogdensburg, New Jersey.
*Slawson, Chester B., Mineralogical Lab., University of Michigan, Ann Arbor, Michigan.
Smith, George, 85 Muston St., Mosman, New South Wales, Australia.
Smith, Norman E., 514 South Ivy Ave., Monrovia, California.
Smith, T. Arthur, 1330 G. St., N. W., Washington, D. C.
Sniffen, E. W., 3111 Boulevard, Hampton, Virginia.
Speiss, Moritz P., Marburg-Lahn, Germany.
Spence, Hugh S., Mines Branch, Sussex St., Ottawa, Canada.
Squires, G. R., 4092 Mayfield Rd., South Euclid, Ohio.
Stafford, J. C., Fort St. James, British Columbia, Canada.
Stadnichenko, Miss T., U. S. Geological Survey, Washington, D. C.
Stanton, Gilman S., 900 West End Ave., New York City.
*Steiger, George, U. S. Geological Survey, Washington, D. C.
Stevens, Albert L., 691 Culver Rd., Rochester, New York.
Stewart, Duncan, 1070 Parker Ave., Detroit, Michigan.
Stow, Marcellus H., Geology Dept., McGraw Hall, Cornell University, Ithaca, New York.
Strock, Lester W., 2008 Wallace St., Philadelphia, Pennsylvania.
Stuckey, J. L., 1911 Sunset Drive, Raleigh, North Carolina.
Sueno, Teirokŭ, No. 484, Okusama, Tamagama-Mura, Ehara-Gun, Tokio-Fu, Japan.
Suffel, G. G., Noranda, Quebec, Canada.
Sullivan, Allan P., 3727 84th St., Jackson Heights, Long Island, New York.
Sugi, Ushichi, 415 Shimo-Ochiai, (near Tokyo), Japan.

Surr, Gordon, Citrus Experiment Station, Riverside, California.
Switzer, George, 827 D St., Petaluma, California.

*Taber, Stephen, Dept. of Geology, University of Souh Carolina, Columbia, South Carolina.
*Tarr, W. A., 704 Westwood Ave., Columbia, Missouri.
Taylor, James A., 57 East 56th St., New York City.
Thompson, M. R., 20 Williams Lane, Chevy Chase, Maryland.
*Thomson, J. Ellis, Dept. of Mineralogy, Mining Building, University of Toronto, Toronto, Canada.
Thowless, Herbert L., 255 Fourth St., Newark, New Jersey.
Tillson, Benjamin F., Mountain Ave., North Caldwell, New Jersey.
Tolman, Carl, Dept. of Geology, Washington University, St. Louis, Missouri.
Tracy, John M., 601 Orange St., Portland, Oregon.
Trainer, David W., Jr., 218 Wait Ave., Ithaca, New York.
Triplett, Ruel B., McKinnon, Wyoming.
Trudell, Harry W., 2030 E. Madison St., Philadelphia, Pennsylvania.
Tucker, Claude H., 4301 South Elati St., Denver, Colorado.
Tunell, George G., Geophysical Lab., Upton St., Washington, D. C.
Tuthill, Miss Isabel H., Rocky Point, New York.
Tuthill, Ralph W., 110 Earl Rd., Michigan City, Indiana.
Tweed, J. R., 908 First Ave., Chisholm, Minnesota.

Vanartsdalen, J. F., Willow Grove, Pennsylvania.
Vance, R. C., 300 Hawley St., Rochester, New York.
Van der Eike, Paul, Dept. of Geology, Junior College, Bakersfield, California.
*Van Horn, Frank R., Case School of Applied Science, Cleveland, Ohio. (Life Fellow).

Vesignie, Jean P. L., 22 Rue du Général Foy, Paris VIII^e, France.
*Von Eckerman, Harry, Sparreholm, Sweden.
*Von Schlichten, Otto, University of Cincinnati, Cincinnati, Ohio.
Vonsen, M., Petaluma, California.

*Walcott, A. J., Dept. of Geology, Northwestern University, Evanston, Illinois.
Waldschmidt, W. A., Midwest Refining Co., Denver, Colorado.
*Walker, T. L., Dept. of Mineralogy, University of Toronto, Toronto, Canada.
*Wallace, R. C., Dept. of Geology, University of Manitoba, Winnipeg, Manitoba, Canada.
Walther, P., 508 Muriel Parkway, Elizabeth, New Jersey.
*Wandke, Alfred, The Guanajuato Consolidated Mining and Milling Co., Guanajuata, Mexico.
Ward, Miss Hilda, 1823 Jefferson Place, Washington, D. C.
*Washington, H. S., Geophysical Lab., Washington, D. C.
*Watanabe, Manjiro, Tohoku Imperial University, Sendai, Japan.
Wedel, Arthur, Box 1163, Jacksonville, Texas.
Weidhass, Ernest, 408 W. 42nd St., New York City.
*Weidman, Samuel, 814 Monett St., Norman, Oklahoma.
Wells, Raymond, Homer, New York.
*Wells, Roger C., U. S. Geological Survey, Washington, D. C.

*Westgate, Lewis G., 124 Oak Hill Ave., Delaware, Ohio.
*Wherry, Edgar T., 27 Oberlin Ave., Swarthmore, Pa.
Whiting, H. C., 602 South Main St., Fairfield, Iowa.
*Whitlock, H. P., American Museum of Natural History, New York City.
*Wigglesworth, Edward, Boston Society of Natural History, 234 Berkeley St., Boston, Mass. (Life Fellow).
Wilber, D. T., Rockefeller Hall, Ithaca, New York.
Willey, L. M., Research Lab., General Electric Co., Schenectady, New York.
Wills, L. C., 5733 Chester Ave., Philadelphia, Pennsylvania.
Wilson, E. H., 37 Forest Ave., Caldwell, New Jersey.
*Winchell, Alexander N., Dept. of Geology, University of Wisconsin, Madison Wisconsin.
Winn, C. R., Box 577, Butte, Montana.
Withrow, James E., Ohio State University, Columbus, Ohio.
Wolf, J. Carlton, 401 South Broadway, Baltimore, Maryland.
*Wolff, John E., 360 South Grand Ave., Pasadena, California.
Woodward, Teynham, Box 5K, Palo Alto, California.
*Wright, Fred E., Geophysical Lab., Washington, D. C.
Wuestner, Herman, 3335 Cavanaugh Ave., Westwood, Cincinnati, Ohio.

Yeaton, Walter J., Dept. of Geology, University of West Virginia, Morgantown West Virginia.

Zell, Lucian M., 522 5th Ave., at 44th St., New York City.
Zodac, Peter, 157 Wells St., Peekskill, New York.

BOOK REVIEW

INTRODUCTORY ECONOMIC GEOLOGY. W. A. TARR. 664 pages and 249 figures. McGraw-Hill Book Co., New York, **1930.** Price **$5.00.**

In this recently published texbook on economic geology, the author reverses the order of treatment commonly used and discusses the metallic resources first. This order of treatment follows logically from his thesis, "All primary mineral deposits (*i.e.*, all aggregates of a mineral or minerals) have their original source in magmas" from which secondary deposits have been formed by weathering. It may require a stretch of the imagination for some to see the connection between deposits of magmatic origin and deposits of coal, petroleum and natural gas, as shown in the "Classification of Mineral Deposits" on page 32.

After discussing the origin of different types of mineral deposits, the author describes each substance individually under the following general headings: history, mineralogy, composition of deposits, gangue minerals, tenor of ores, descriptions of the more important mineral deposits in the United States, foreign deposits, uses and production.

Aside from the clear presentation of the subject matter, there are a number of features which are worthy of commendation. For example, materials which are associated in use are associated in the book; thus, the discussion of iron is followed by a discussion of the ferroalloy metals. The general use of graphs instead of numerical data to show the statistics of production is a decided improvement over most other textbooks on the subject.

CHARLES W. COOK

NEW MINERAL NAMES

Ramdohrite

Friedrich Ahlfeld: Ramdohrit, ein neues Mineral aus Bolivien. (Ramdohrite, a new mineral from Bolivia). *Centr. Min. Geol.*, Abt. A, No. 8, pp. 365–367, 1930.

Name: In honor of Prof. Ramdohr, a German mineralogist.

Chemical Properties: A sulf-antimonide of lead and silver, $Ag_2S \cdot 3PbS \cdot 3Sb_2 \cdot S_3$. Analyses I (by R. Huegel) S 20.4, Sb 32.8, Pb 30.6, Ag 9.6, Cu 0.3, gangue 6.6; Sum 100.3. II (by Dr. W. Brendler) S 20.1, Sb 31.1, Pb 30.3, Bi 2.5, Ag 10.1, Cu 0.3, Fe 0.3, gangue 5.5; Sum 100.2.

Physical Properties: Color dark gray, somewhat bluer than jamesonite. Streak gray black. H. 2, Sp. Gr. 4.18. Fracture uneven. Brittle.

Occurrence: Found in a silver-tin vein in the mine Chocaya la vieja, Province of Nor Chichas, Department of Potosi. It forms long prismatic to thick lance-shaped reticulating individuals in fine grained quartz, associated with pyrite, stannite and sphalerite.

W.F.F.

TEACHING FELLOWSHIP IN MINERALOGY

A teaching fellowship in mineralogy has been established at Stanford University. This fellowship is open to graduate students who intend to specialize in mineralogy and preference will be given to those who have had one year of graduate work. The chief duty of the *fellow* is to assist in laboratory instruction. Not more than eight or nine hours work a week will be required. The amount of the fellowship is $750.

Application for the year 1931–32, accompanied by testimonial letters, should be made to Professor A. F. Rogers, Box 87, Stanford University, California.